

Applicant: Hsu-Sheng Yu
Application No. 10/713,764
Page 2 of 6

P910259

Amendments to the Claims

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This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1. (Currently Amended) A method for forming shallow trench isolation structures, the method comprising:

~~providing~~ forming a mask upon a substrate having a cell region and a periphery region;

~~forming a hard mask upon the substrate~~ so as to cover at least a portion of the cell region and at least a portion of the periphery region;

forming a patterned photoresist layer upon the ~~hard~~ mask, the photoresist layer exposing a portion of the ~~hard~~ mask in the cell region and exposing a portion of the ~~hard~~ mask in the periphery region;

performing a first etching process to remove substantially all of the ~~hard~~ mask layer exposed by the photoresist layer in the periphery region and to remove a portion of the ~~hard~~ mask layer exposed by the photoresist layer in the cell region;

performing a second etching process to partially form a trench having rounded corners in the periphery region and to remove more of the ~~hard~~ mask layer in the cell region;

performing a third etching process to deepen the trench formed in the periphery region while maintaining the rounded corners thereof and to form a trench in the cell region; and

filling the trench in the periphery region and filling the trench in the cell region with an insulating material.

2. (Original) The method as set forth in claim 1, further comprising removing the photoresist after performing the third etching process.

3. (Currently Amended) The method as set forth in claim 1, further comprising removing the ~~hard~~ mask after filling the trench with an insulating material.

Applicant: Hsu-Sheng Yu
Application No. 10/713,764
Page 3 of 6

P910259

4. (Currently Amended) The method as set forth in claim 1, further comprising forming a pad oxide layer upon the substrate prior to forming the ~~hard~~ mask thereon.
5. (Currently Amended) The method as set forth in claim 1, further comprising forming a pad oxide layer upon the substrate prior to forming the ~~hard~~ mask thereon and removing the pad oxide layer after filling the trenches with an insulating material.
6. (Currently Amended) The method as set forth in claim 1, wherein performing a first etching process comprises removing all of the ~~hard~~ mask layer exposed by the photoresist layer in the periphery region.
7. (Currently Amended) The method as set forth in claim 1, wherein performing a second etching process comprises removing substantially all of the ~~hard~~ mask layer exposed by the photoresist layer in the cell region.
8. (Currently Amended) The method as set forth in claim 1, wherein the ~~hard~~ mask layer comprises a silicon nitride layer.
9. (Original) The method as set forth in claim 1, wherein the corners of the trench formed in the cell region are not substantially rounded.
10. (Original) The method as set forth in claim 1, wherein an etching gas of the first etching process comprises one of $\text{CF}_4/\text{CH}_2\text{F}_2$ and CF_4/CHF_3 .
11. (Original) The method as set forth in claim 1, wherein an etching gas of the second etching process comprises CF_4/CHF_3 .
12. (Original) The method as set forth in claim 1, wherein an etching gas of the third etching process comprises Cl_2/O_2 .

Applicant: Hsu-Sheng Yu
Application No. 10/713,764
Page 4 of 6

P910259

13. (Original) The method as set forth in claim 1, wherein filling the trench in the periphery region and filling the trench in the cell region comprise filling the trench in the periphery region and the trench in the cell region with the same material.

14. (Original) The method as set forth in claim 1, wherein filling the trench in the periphery region and filling the trench in the cell region comprise filling the trench in the periphery region and the trench in the cell region with an oxide during a single processing step.

15. (Original) The method as set forth in claim 1, wherein filling the trench in the periphery region and filling the trench in the cell region comprise filling the trench in the periphery region and the trench in the cell region with silicon dioxide.

16. (Original) The method as set forth in claim 1, wherein the round corners of the trench formed in the periphery region have a radius between approximately 30 nm and approximately 60 nm.

17. (Original) The method as set forth in claim 1, wherein the round corners of the trench formed in the periphery region have a radius of about 60 nm.

18. (Original) The method as set forth in claim 1, wherein the trench in the periphery region and the trench in the cell region are formed so as to have approximately the same depth.

19. (Currently Amended) A method for forming trenches for shallow trench isolation structures, the method comprising:

etching a ~~hard~~ mask of a periphery region deeper than a ~~hard~~ mask of a cell region during a first etching process;

etching the ~~hard~~ mask of the cell region further and etching ~~the~~ a substrate of the periphery region so as to partially form a trench having rounded corners during a second etching process; and

Applicant: Hsu-Sheng Yu
Application No. 10/713,764
Page 5 of 6

P910259

etching the substrate in the cell region so as to form a trench in the cell region and etching the substrate in the periphery region so as to deepen the trench formed therein during a third etching process.

20. Cancelled.

21. (Currently Amended) A method for forming trenches for shallow trench isolation structures, the method comprising:

etching a ~~hard~~ mask of a periphery region approximately down to a pad oxide layer and etching a ~~hard~~ mask of a cell region less than down to a pad oxide layer so as to leave a remaining portion of the exposed ~~hard~~ mask of the cell region during a first etching process;

etching the remaining portion of the exposed ~~hard~~ mask of the cell region approximately down to the pad oxide layer and etching the a substrate of the periphery region so as to form a trench having rounded corners during a second etching process; and

etching the substrate in the cell region so as to form a trench therein and etching the substrate in the periphery region so as to deepen the trench formed therein during a third etching process.

22-25. Cancelled.